भारतीय मानक
*Indian Standard*

**IS 7312 : 2018**

# वेल्ड किए तथा जोड़ सहित इस्पात के घुली ऐसिटिलीन के गैस सिलिंडर — विशिष्टता

*( तीसरा पुनरीक्षण )*

# Welded and Seamless Steel Dissolved Acetylene Gas Cylinders — Specification

*( Third Revision )*

ICS 23.020.30



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली-110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.org.in www.standardsbis.in

**September 2018** **Price Group 8**

Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Mechanical Engineering Division Council.

The standard was first published in 1974 when the manufacture of acetylene cylinders had not commenced in India. This standard was subsequently revised in 1982 and 1993, when the manufacture of acetylene cylinders had commenced in India. ISO 3807 "Dissolved Acetylene Cylinders — Basic requirement has been revised, This revision was to align with ISO 3807 : 2013 and included seamless cylinders also.

This revision is being undertaken to incorporate the following:

a) Modification in the definition of dissolved acetylene cylinder.
b) Inclusion of crushing strength for the porous mass.
c) Inclusion bonfire of test.
d) Modification of method of measurement of the gap between porous mass and the shell.
e) To refer the test methods specified in IS 3196 (Part 3) : 2012 Welded Low Carbon steel gas cylinder exceeding 5 liter water capacity for low pressure liquefiable gases : Part 3 Methods test (*fifth revision*).

The bonfire test was adopted from Australian Standard No. B. 189-1962. Welded capsule type steel cylinders for acetylene published by Standards Association of Australia.

Manufacture and filling of dissolved acetylene gas when contained in cylinders is regulated by the *Gas Cylinder Rules*, 2016 of the Government of India .This specification has been prepared in consultation and agreement with the concerned statutory authorities.

The composition of the Committee responsible for the formulation of this standard is given in Annex F.

For the purpose of deciding whether particular requirement of this standard is complied with the final value observed or calculated, expressing the result of test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values' (*revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

The relevant SI units and the corresponding conversion factors are given below for guidance.

Pressure 1 Pa (Pascal) = 1 $N/m^2$

1 $kgf/mm^2$ = 9.806 65 MPa

*Indian Standard*

# WELDED AND SEAMLESS STEEL DISSOLVED ACETYLENE GAS CYLINDERS — SPECIFICATION

*( Third Revision )*

## 1 SCOPE

This specification covers the requirements for portable welded or seamless dissolved acetylene gas cylinders made of steel and having nominal water capacity within the range 0.5 liters and up to and including 130 litres. This standard lays down the requirements for the materials, design, manufacture, construction, tests and marking of these cylinders.

## 2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions to this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

## 3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 7241 and the following shall apply.

**3.1 Dissolved Acetylene Cylinder** — A cylinder having a valve and with or without safety devices filled with porous mass a solvent for the storage of dissolved acetylene and at least sufficient quantity of Acetylene to saturate acetone (*see* IS 170) as solvent at atmospheric pressure and at a temperature of 15°C.

**3.2 Cylinder Shell** — An empty cylinder, manufactured and suitable for receiving and containing a porous mass and to be fitted as part of an acetylene cylinder.

**3.3 Fusible Plug** — Non reclosing pressure relief device designed to function by the yielding or melting of a plug of fusible material at a predetermined temperature.

**3.4 Manufacturer of Acetylene Cylinder** — Company responsible for filling the cylinder shell with porous mass (porous material) and which generally prepares it for the first charge of acetylene.

**3.5 Maximum Acetylene Content** — Specified maximum weight of acetylene including saturation gas in an acetylene cylinder.

**3.6 Porous Mass (Porous Material)** — Single or multi-component material introduced or formed in the cylinder shell in order to fill it and that, due to its porosity, allows the absorption of the solvent/acetylene gas solution.

NOTES

**1** The porous mass may be monolithic or non monolithic

**2** Monolithic porous mass, consisting of a solid product typically obtained by reacting materials or by bonding materials together with a binder.

**3** Non-monolithic porous mass, consisting typically of granular, fibrous or similar materials without addition of a binder.

**3.7 Porosity** — Ratio of total volume (water capacity) of the cylinder shell minus the volume of the solid material of the porous mass to the water capacity of the cylinder shell.

**3.8 Saturation Gas** — Acetylene dissolved in the solvent in the cylinder at atmospheric pressure (1.013 bar) and at a temperature of 15°C.

**3.9 Solvent** — Liquid that is absorbed by the porous mass and is capable of dissolving and releasing acetylene.

**3.10 Specified Solvent Content** — Weight of solvent (*see* **3.9**) that the acetylene cylinder shall contain that is established during prototype testing.

**3.11 Tare Weight** — Means the weight of the cylinder shell together with any fittings, permanently attached and includes the weight of valve any safety device, porous mass, requisite quantity of solvent (*see* **3.10**) for dissolving acetylene, and the weight of acetylene gas saturating the solvent at atmospheric pressure and temperature of 15°C;

**3.12 Water Capacity** — Actual capacity of the cylinder shell as defined in **3.2** measured by filling the cylinder shell with water.

**3.13 Working Pressure** — Settled pressure at a uniform reference temperature of 15°C in a cylinder containing the specified solvent content and the maximum acetylene content.

NOTE — For determination of the working pressure *see* Annex D.

**3.14 Test Pressure** — The internal pressure required

for the hydrostatic stretch test of the cylinder shell before filling the porous mass. It is equal to 5 880 KPa (60 kgf/cm$^2$) for cylinders without fusible plug and 5 194 KPa (53 kgf/cm$^2$) for cylinders with fusible plug when acetone is the solvent.

## 4 MATERIAL

**4.1** The steel used in the manufacture of cylinders shall conform to IS 6240. For seamless cylinders **6.3** may be referred.

**4.1.1** Suitable low carbon steel other than those given in **4.1** may be used with the prior permission of the statutory authority. In such a case the minimum specified value of yield strength of the steel specification shall be used for the purpose of calculating the wall thickness of the cylinder. Such a steel shall be certified by the steel maker to be other than of rimming quality suitable for pressing or drawing with acceptable non-ageing properties and shall be fully killed.

**4.1.2** The cylinder manufacturer shall obtain and provide certificate of cast (heat) analysis of the steels supplied for the construction of gas cylinders and establish means to identify the cylinders with the casts of steel from which they are made.

**4.2** The bung/valve pad shall be hot forged from rolled steel either conforming to class 1A or 2 of IS 1875 or IS 2062 or IS 7283 or IS 9550.

**4.3** The material used for footring shall conform to Grade HR1 of IS 1079 or any other steel equivalent or superior qualities.

## 5 GENERAL

A fully dimensioned sectional drawing of the cylinder, together with design-calculations and scheme of manufacture, shall be submitted by the manufacturer to the inspecting authority for final approval by statutory authority.

## 6 DESIGN

**6.1** A cylinder shall be of welded construction having a cold drawn or hot drawn cylindrical portion with hemispherical, ellipsoidal or semispherical ends welded to it or two halves of halves of cold or hot drawn and circumferentially welded together, or any other construction approved by the statutory authority.

**6.2** The calculation of the thickness of pressure parts of the gas cylinder is related to the minimum value of yield strength of the material specified in **4.1** and **4.1.1** and the test pressure.

**6.2.1** The agreed finished thickness shall not be lower than that calculated from the following formulae:

a) For cylindrical portion, greater of the following two:

1) $$t = \frac{P_h D_o}{200 \times 0.8\, J\, R_e + P_h}$$

$$= \frac{P_h D_1}{200 \times 0.8\, J\, R_e - P_h}$$

OR

2) $$t = 0.136 \times \sqrt{D_o}$$

b) For torispherical part or end ( see Fig. 1A):

$$t = \frac{P_h D_o}{200 \times 0.8\, J\, R_e + P_h} \times \frac{KZ}{5}$$

c) For semi-ellipsoidal part or end (*see* Fig 1 B):

$$t = \frac{P_h D_o}{200 \times 0.8\, J\, R_e + P_h} \times \frac{K\left(0.65 + 0.1K\right)}{4}$$

where

$t$ = Calculated minimum wall thickness of cylindrical shell in mm excluding any additional thickness to resist influences other than those of internal pressure and of external forces due to normal handling (*see* **8.4**);

$P_h$ = Hydrostatic test pressure above atmospheric in kgf/cm$^2$;

$D_1$ = inner diameter in mm;

$D_o$ = Outer diameter in mm;

$J$ = Weld joint factor;

= 1.0 if each weld is to be fully radiographed;

= 0.9 for cylinders with circumferential seam or seam only ( not radiographed);

= 0.9 for cylinders with seams other than circumferential which are spot radiographed in accordance with **13.2**.

$R_e$ = Yield strength (minimum value specified in **4.1** and **4.1.1**) in kgf/mm$^2$ ;

$H$ = Depth of dishing, in mm;

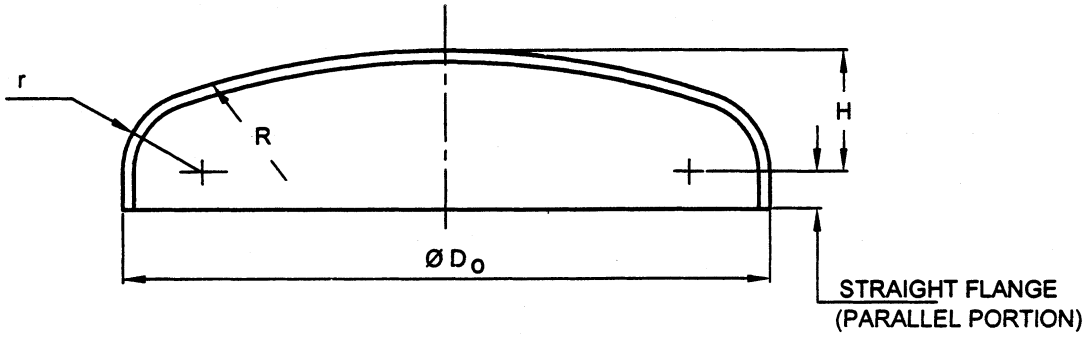
$K$ = The ratio $D_o/H$,

$R$ = Dishing radius, in mm ( $R \leq D_o$);

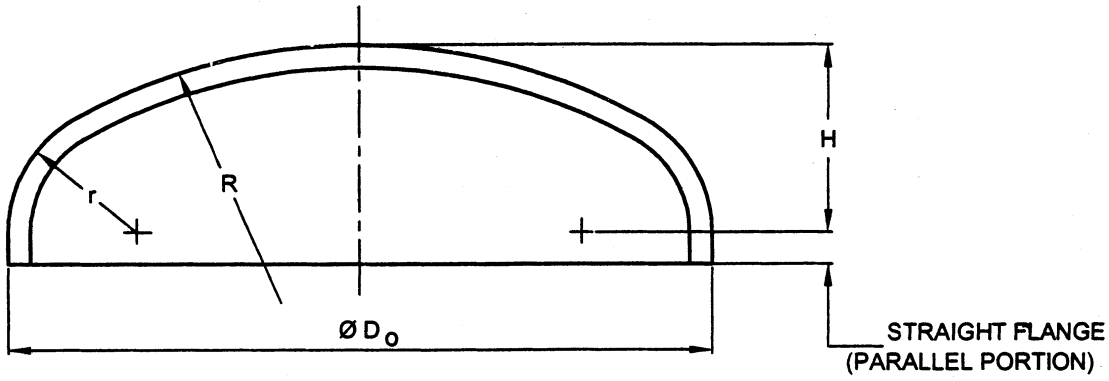
$r$ = Knuckle radius, in mm ( $r \geq 0.1\, D_o$ ); and

$$Z = \left(\frac{20r}{R} + 3\right) \Big/ \left(\frac{20r}{R} + 1\right)$$

**6.2.1.1** For hemispherical ends or parts, the minimum calculated thickness need not exceed that of the cylindrical portion of the cylinder.




a) TORISPHERICAL END




b) SEMI-ELLIPSOIDAL END

FIG. 1 TORI-SPHERICAL AND SEMI-ELLIPSOIDAL END

**6.2.1.2** When concave bottoms are applied (*see* Fig. 2) the design shall be, such that the following minimum values are guaranteed by the cylinder manufacturer:

$t_1 = 2t$, $t_2 = 2t$, $h = 0.1\ D_o$ and $r = 0.075\ D_o$.

**6.2.2** The thickness of the shell shall not be less than 2.5 mm for cylinders up to and including 10 litres water capacity and not less than 3.5 mm for cylinders above 10 litre water capacity. The actual thickness of the end or dished part shall not be less than the thickness of the cylindrical portion.

**6.3** The cylinders of seamless construction shall conform to IS 7285 (Part 1) or Part 2 regarding material, design, manufacture, heat treatment, fitting and testing. The serial number punched on the seamless shell by its manufacturer shall continue as the serial number of the dissolved acetylene gas cylinder. No fusible plug or safety device shall be fitted on the body of seamless cylinder.

**6.4** Before the design is finally approved, the statutory authority may require one or more prototype cylinders to be subjected to various tests as specified in this specification or such other tests, as authority deems fit.

## 7 WELDING

**7.1** The cylinder shall be welded by any suitable fusion welding method and shall conform, as for welding procedure and welder's performance qualifications, to the requirements of IS 2825 or IS 817.

**7.2** Before welding, the plates to be joined shall be free from scale, grease, oil and dirt. Before the cylinders are closed, longitudinal welds, wherever used, shall be visually examined from both sides to ensure that the welds are satisfactory.

**7.3** Welds shall have an even finish and shall merge into the parent material without undercutting or abrupt irregularity.

**7.4** Welding consumables used shall be such that the desired properties of the weld are obtained and the physical values of the welded metal are not lower than the specified values of the parent metal.

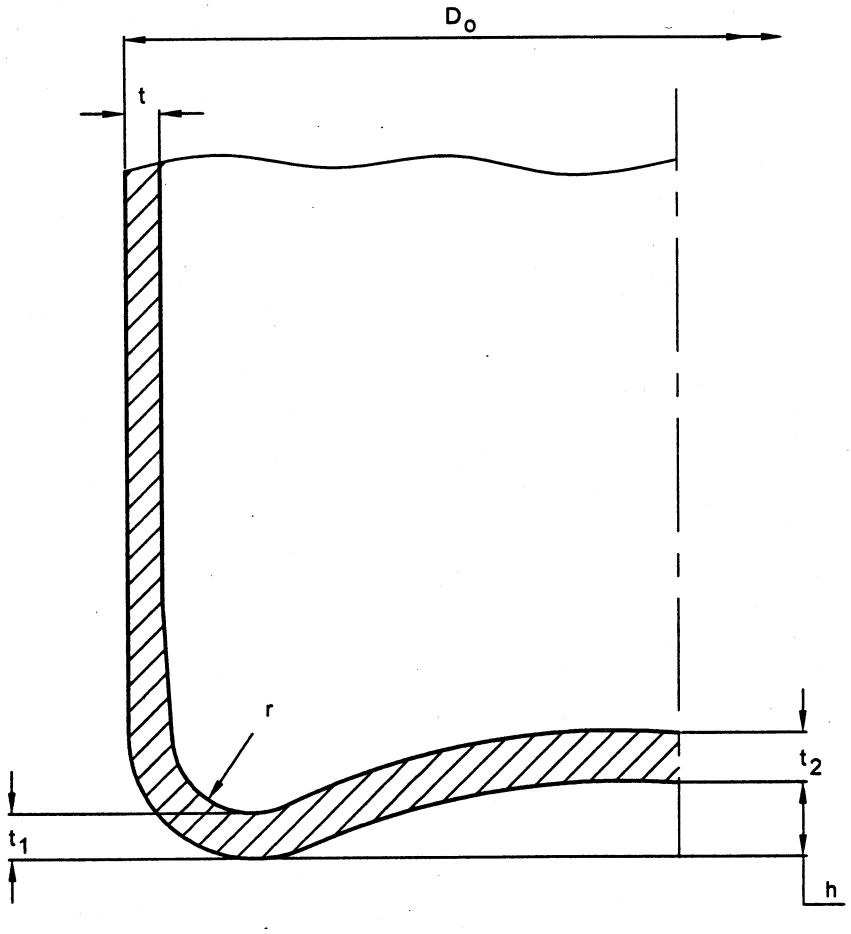



FIG. 2 CONCAVE BOTTOM

**7.5** The chemical composition of the weld metal shall be compatible with that of the parent metal.

**7.6** Where the cylinder shells with joggle welds are used, it shall be verified that the welds do not damage the porous mass in accordance with Annex E.

## 8 MANUFACTURE

**8.1** The number of longitudinal seams in the welded cylinder shall not exceed one and the number of circumferential seams shall not exceed two.

**8.2** When the welded cylinder contains a longitudinal seam, the edges of the plate forming the longitudinal joint of the shell shall be rolled or formed by pressure, not by blows, to the required curvature.

**8.3** The end or dished part shall be of hemispherical, semi-ellipsoidal or torispherical shape. These shall be either forgings, suitably thickened at the neck, or pressed ends with provision for welding to it a bung/valve pad to take the valve. The end shall have a cylindrical skirt or parallel portion of minimum length 20 mm or three times the shell thickness, whichever is greater.

### 8.4 Agreed Finished Thickness

The agreed finished thickness shall not be less than the minimum calculated wall thickness obtained by the application of formulae given in **6.2.1** at any point and at any transverse section of the cylindrical portion. Additional thickness may also have to be provided to cover corrosion allowance and stresses due to horizontal acceleration and retardation during transportation. The amount of this allowance shall be as agreed to between the manufacturer and the purchaser.

### 8.5 Examination of Cylinders Before Closing in Operation

Cylinders shall be examined for wall thickness, before the closing in operation, circularity of the cylindrical shell and the skirt portion of ends, external and internal surface defects, the profile regularity of the ends, offset at the joints and straightness. The manufacturer shall assure himself that the wall thickness is not less than the agreed finished thickness at any point.

**8.5.1** *Circularity*

The out of roundness of the cylindrical shell shall be limited to such a value that the difference between the maximum and the minimum outside diameter in the same cross section is not more than one percent of the mean of these diameters.

**8.5.2** *Surface Defects*

The internal and external surfaces of the cylinder shall be free from defects which will adversely affect the safe working of the cylinder.

**8.5.3** *Profile Regularity*

The contour of the dished end shall not deviate from the approved dimensions by more than 1.25 percent of the nominal diameter in respect of radial dimensions and by more than one percent in respect of axial dimensions. Such deviations shall not be abrupt changes and shall be outside the specified shape.

**8.5.4** *Offset at the Joint*

The misalignment measure at the surface of the plates shall not exceed 10 percent of the nominal plate thickness. Where the thickness of the ends exceeds the shell thickness by more than 25 percent, the abutting edges shall be reduced by a smooth taper extending for a distance of four times the offset between the abutting edges.

**8.5.4.1** Before any welding is commenced, it shall be ascertained that the chamfered edges are in alignment and that the defects in alignment, the surface of the plates are less than:

a) For plates of thickness 5 mm or less—t/6 for a longitudinal seam and t/4 for circumferential seam, subject to a maximum of 1 mm;

b) For plates over 5 mm in thickness — It shall be ascertained that the prepared edges are in alignment to meet the requirements of the welding process and that the defects in alignment and the surface of the plates are not more than :

   1) 10 percent of the nominal plate thickness with a maximum of 3 mm for longitudinal joint, However, for plates up to and including 10 mm thick a misalignment of 1 mm is permitted.

   2) 10 percent of the maximum nominal plate thickness plus 1 mm with a maximum of 4 mm for circumferential joints.

NOTE — Welds made with backing strips require better alignment than specified above.

**8.5.5** *Straightness*

Unless otherwise shown on the drawing, the maximum deviation of the shell from a straight line shall not exceed 0.3 percent of the cylindrical length.

## 9 VALVES AND VALVES PAD

**9.1** The valve connection shall consist of a welded or brazed pad/bung, and shall be threaded to suit the type of valve specified in IS 3224. If welding is adopted, two runs of welding shall be employed for bungs which have a backing pad (either on the outside or one on the outside and one on the inside). In the case of bungs without backing pad, one run of welding shall be given on the inside and one on the outside. In the case of bungs without backing pad but having a chamfer on the bung providing compound weld joint (butt and fillet) between bung and top dished end, the same may be welded only on the outside with two runs of weld.

### 9.2 Valve Protection

The valve shall be protected by a stout metal cap perforated for ventilation and of thickness not less than 3.5 mm, screwed on to the neck, or in any other manner approved by the statutory authority.

### 9.3 Valves

The valves for the cylinders shall conform to IS 3224. The cylinders of seamless construction according to **6.3** shall be fitted with valves having safety device. However, cylinders for marine application shall not have any safety device.

## 10 FITTINGS OTHER THAN VALVES

### 10.1 Footring

The footring, where fitted as a separate fixture to the bottom end of the cylinder, shall be at least 20 mm away from the circumferential weld. The thickness of the sheet from which the footring is made shall not be less than the calculated wall thickness of the cylinder body. The footring may be intermittently welded. In case, the bottom edge is curled, the curling shall be inwards to facilitate safe handling. It shall be provided with holes for ventilation, and if curled drainage holes to be provided to avoid corrosion. The maximum permissible deviation from the vertical shall not exceed 1 percent. Footrings shall be sufficiently strong and made of steel compatible with that of the cylinder prescribed in IS 1079, or of other steel having equivalent properties. The bottom of the footring shall not be less than 8 mm below the outside bottom of the cylinder shell for cylinders up to 34 liters nominal water capacity. For cylinders of more than 34 liters nominal water capacity and up to 50 liters nominal water capacity, this value shall be minimum 15 mm and for cylinders exceeding 50 liters nominal water capacity, this value shall be minimum 25 mm.

### 10.2 Safety Devices

**10.2.1** Fusible plug provided for welded cylinders shall conform to IS 13497 or equivalent as approved by statutory authority.

**10.2.2** Safety devices shall be positioned on the bung valve pad of the welded cylinders on both sides of the valve shank opening.

## 11 HEAT TREATMENT

All cylinders shall be efficiently normalized, or stress relieved in accordance with the steel maker's recommendation after manufacture and completion of all welding (including that of attachments) and before hydrostatic test is applied, by any suitable method at a temperature in excess of 600°C. Liquid quenching is not permissible. A complete record of the heat treatment cycle shall be maintained.

## 12 INSPECTION

### 12.1 General

**12.1.1** The inspecting authority shall have free access, at all reasonable time to that part of the manufacturer's works engaged in the order. They shall also be at liberty to inspect the fabrication at any stage and to reject any cylinder, or part of a cylinder, that does not comply with the requirements of this standard.

**12.1.2** The Manufacturer shall supply the man power and equipment for such inspection and tests as are required and for any additional checks which may be agreed between the inspecting authority and the manufacturer.

**12.1.3** The visual inspection of cylinders shall be carried out and the limits of defects shall be as given in IS 9639.

### 12.2 Inspection of Components

**12.2.1** All pressings, halves and cylindrical shells shall be examined for surface defects before any seams is welded. If there are defects which, in the opinion of the inspecting authority, would be detrimental to the sound construction of the container, the pressing or shell shall be rejected.

**12.2.2** At the discretion of the inspecting authority, 2 percent or more of the pressings, halves and the cylindrical shells shall be selected at random to represent all batches of material used for the manufacture of the cylinders, and these batches shall be examined for minimum thickness before any seam is welded.

**12.2.3** Should any pressing, half or shell be less than the minimum specified thickness, the whole output from the relevant batch of material shall be examined for minimum thickness, and any pressing or shell which is less than the specified minimum thickness shall be rejected.

**12.2.3.1** For the purpose of this clause 'batch of materials' is defined to mean pressings or cylindrical shells manufactured in a continuous production run.

## 13 RADIOGRAPHIC EXAMINATION

**13.1** Radiographic examination with X-ray when required, shall conform to the techniques and acceptability criteria set forth in the relevant Indian Standards. For general guidance, reference may be made to IS 1182 and **8.7** of IS 2825. The radiographic technique used shall be sufficiently sensitive to reveal a defect having a thickness equal to 2 percent of the combined thickness of the weld and the backing material.

### 13.2 Spot Radiography (*see* definition under 6.2.1)

**13.2.1** One out of every 50 consecutive cylinders from continuous production shall be taken at random for spot radiography.

**13.2.2** In addition, after a change in the type or size of cylinder or the welding procedure (including machine settings), or after a break in the production exceeding four hours, the first cylinder welded shall be taken for spot radiography.

**13.3** The film density shall be up to 3 and in no case shall not be less than 1.7.

**13.4** *See* **10** of IS 3196 (Part 3) for testing details of radiography.

## 14 CHECKING OF WATER CAPACITY

The water capacity of the cylinders shall be checked. This shall be done by weighing or by volumetric method. Water capacity of the cylinder shall have a tolerance of $^{+3}_{-0}$ percent on the declared value.

## 15 HYDROSTATIC TESTS

### 15.1 Hydrostatic Stretch Test

Each heat treated cylinder shall be subjected to a hydrostatic stretch test. No pressure greater than 80 percent of the test pressure shall have been applied to the cylinder before the test.

**15.1.1** Hydrostatic stretch test shall be carried out accordingly to IS 3196 (Part 3) using 'non jacket' method.

**15.1.2** Permanent volumetric expansion suffered by the cylinder due to application of test pressure shall not exceed 7.5 percent of the total volumetric expansion at the pressure.

### 15.2 Hydrostatic Test

Cylinder which passes the test given in **15.1** shall be subjected to hydrostatic test. During the hydrostatic test, the pressure shall be increased gradually till 95 percent of the test pressure is reached. After this pressure is reached, the external surfaces of the cylinder are dried and the pressure shall be retained for a period of not less than 30 s. Any reduction in pressure noticed during this retention period or any leakage or visible bulge or deformation shall be treated as a case of failure in the test.

**15.2.1** The values of hydrostatic test pressure shall be in accordance with **3.15**.

**15.2.2** Hydrostatic test shall be carried out according to IS 3196 (Part 3).

**15.2.3** The tests specified in **15.1** and **15.2** may be carried out at the same time.

## 16 PNEUMATIC LEAKAGE TEST

**16.1** Subsequent to hydrostatic tests, each cylinder, after it has been dried, shall be tested for leakage by subjecting to air pressure of not less than 3 920 kPa (40 kgf/cm$^2$) for a period of one minute while immersed in water and shall show no leakage.

**16.1.1** Alternatively any other method approved by the statutory authority may be used.

**16.1.2** Pneumatic leakage test shall be carried out according to IS 3196 (Part 3).

## 17 BURST TEST

**17.1** One cylinder selected at random from a batch of 403 hydrostatic test passed cylinders shall be subjected to a hydrostatic pressure till it bursts.

**17.2** Bursting test shall be carried out according to IS 3196 (Part 3).

**17.3** The nominal hoop stress value of the cylinder shall be not less than 0.95 of the minimum specified tensile strength of the material of the cylinder. The cylinder shall burst without fragmentation. During burst test in case leakage starts from any welding before fracture or before achieving required hoop stress the specimen shall be discarded and fresh test specimen shall be taken. Fracture shall not occur in the weld in the direction of the circumferential or longitudinal seam. The fracture shall also not occur in the direction parallel to circumferential weld within 10 mm from the edge of the circumferential weld.

## 18 ACCEPTANCE TESTS

**18.1** For every batch of 202 or less heat treated and finished cylinders, one test cylinder shall be selected at random, and the various acceptance tests shall be carried out on test specimens taken from this cylinder.

**18.1.1** Number of test specimens and method of testing shall be in accordance with IS 3196 (Part 3).

**18.1.2** The percentage elongation and yield strength, wherever applicable, and tensile strength thus determined shall not be less than the respective requirements for the material specified in **4**.

**18.1.3** The bend test specimen having cracks or any other open defects, which exceed 3 mm, measured in any direction on the convex surface of the specimen, shall be treated as a failure.

**18.1.4** The weld shall show a good penetration and absence of lack of fusion.

**18.1.5** The thickness shall not be less than the calculated thickness.

## 19 TECHNICAL REQUIREMENTS FOR ACETYLENE POROUS FILLING MASS AND SOLVENT

### 19.1 Acetylene

**19.1.1** The quantity of the acetylene stored in the cylinder (excluding the acetylene required to saturate the solvent at atmospheric pressure and a temperature of 15°C) shall not exceed the amount authorized for the cylinder and permanently marked on the cylinder.

**19.1.2** When the cylinder has been charged with acetylene and the pressure has reached equilibrium the maximum gauge pressure in the cylinder with acetone as the solvent shall not exceed 1 568 kPa (16 kgf/cm$^2$) at 15°C. This shall be confirmed using the formula given in Annex D.

### 19.2 Porous Material

**19.2.1** Every cylinder shall be filled with a porous material filling approved by the statutory authority. The porous material shall be compatible with the cylinder shell, the solvent and acetylene and shall not form dangerous or harmful products with these. For common porous materials consisting of inert materials (for example calcium silicate hydrate), this is generally the case.

**19.2.2** Cylinders with porous mass shall be subjected to vibration test as given in **20.4** to ensure no air pockets of appreciable size in porous mass .

**19.2.3** The porous filling material shall be of such structure that it will not disintegrate or sag when wet with solvent or when subjected to normal service. The porous filling material shall be uniform in quality and free of voids, except that a well drilled into the firing

material beneath the valve is permissible provided that the well be filled with a material of such type that the functions of the filling material are not impaired. Overall shrinkage of the filling material is permissible provided that the total clearance between the cylinder shell and filling material does not exceed 0.5 percent of the respective diameter or length but in no case of exceed 3.2 mm measured diametrically and longitudinally and that such clearances do not impair the functions of the filling material.

**19.2.4** The porosity of the porous filling shall be in the range of 75 to 92 percent with a tolerance of ± 2 percent on nominal declared value as determined by the method prescribed in Annex B.

**19.2.5** The crushing strength of the porous filling shall be 2 156 kN/m$^2$ (22 kgf/cm$^2$) minimum as determined by the method prescribed in Annex C. If sample fails in requirement of crushing strength of the porous mass and if the inspecting authority considers that the failure was due to an error in carrying out the test, a fresh test shall be done on a test piece taken from the same cylinder. The defective test shall be ignored, but otherwise, the following procedure shall be adopted. The test shall be repeated on the same cylinder and in addition, one cylinder shall be drawn at random from the same control unit and tested. If any of the samples fails, the particular control unit shall be rejected and cylinders of that particular control unit shall be rendered unserviceable for holding the gas. From the rest of the batch, one cylinder from each control unit shall be selected at random and cylinders shall pass or fail, control unit wise depending upon the results of crushing strength as laid down in this clause. Cylinders of rejected control unit shall be rendered unserviceable for holding the gas and shall be destroyed.

**19.2.6** For safety reasons, the porous material shall be able to prevent the propagation of an acetylene decomposition within the cylinder and shall be of such quality that it enables the acetylene cylinder to meet the requirements of **20.3** and **20.5**.

**19.2.7** Acetylene cylinders equipped with fusible plugs shall pass the fire test described in **20.6** in addition.

**19.2.8** Where cylinder shells with joggle welds are used, it shall be verified that the welds do not damage the porous material in accordance with Annex E.

### 19.3 Solvent and Acetylene Content

**19.3.1** The solvent shall be compatible with the cylinder shell. The commonly used solvents are acetone and DMF. Only approved solvent approved by the statutory authority shall be used. Acetone, if used, shall comply with the requirements of IS 170.The specified solvent and the maximum acetylene content including the gas in solution shall be such that the cylinder meets the requirements of type tests specified in **20.**

**19.3.2** In addition to the requirement specified in the section **19.3.1**, the maximum amount of acetone filled in a cylinder shall be proportioned to the porosity of the porous mass and the volumetric capacity of the cylinder in the following scale:

| *Porosity* Percent | *Maximum Acetone Content in Percent of Water Capacity of Cylinder, by Volume* | |
|---|---|---|
| | For Cylinders having Nominal Water Capacity not Exceeding 9 Litres | For Cylinders having Nominal Water Capacity Exceeding 9 Litres |
| Over 75 up to and Including 80 | 34.8 | 36.2 |
| Over 80 up to and Including 83 | 37.1 | 38.6 |
| Over 83 up to and Including 87 | 38.5 | 40.0 |
| Over 87 up to and Including 90 | 38.5 | 40.0 |
| Over 90 up to and Including 92 | 41.8 | 43.4 |

## 20 PROCEDURE FOR TYPE APPROVAL OF DISSOLVED ACETYLENE CYLINDERS

### 20.1 Approval Requirements

**20.1.1** A request for approval for acetylene cylinders may cover a range of different cylinder sizes provided that:

a) The cylinders contain the same porous mass and same solvent.
b) The maximum acetylene content per litre water capacity of the cylinder shell is the same
c) The specified solvent content per litre water capacity of the cylinder shell is the same.
d) The construction of the cylinder shells shall be similar i.e. welded (with circumferential joggle welds or cylinders with butt welds only) or Seamless cylinders
e) the nominal outside diameter of the cylinders falls within the range of either:
   1) ≤ 270 mm, or
   2) > 270 mm

**20.1.2** *Selection of Test Cylinders*

a) For cylinders with a nominal water capacity above 50 litre and up to 130 litre, the

inspecting authority shall select cylinders for test with a capacity considered to be representative of the size under consideration.

b) For cylinders with a nominal water capacity between 10 litre and 50 litre, tests shall be on the smallest and the largest cylinders of every range proposed by the manufacturer meeting requirement **20.1.1**.

c) For cylinders with a nominal water capacity below 10 litre, no test need be carried out on cylinders having maximum acetylene content of not more than 90 percent of the equivalent proportional content used in approved cylinders of water capacity more than 10 litre. However, in such case the maximum acetylene content per volume (water capacity) shall not exceed 0.180 kg/litre. For cylinders having a higher acetylene content, tests shall be carried out on cylinders with a nominal water capacity representative size under consideration.

**20.1.3** *Information to be Supplied*

Each request for approval shall include the following information:

a) A Schedule of the different constructions and sizes of acetylene cylinders which form the subject of the request for approval and which includes, for each size of cylinder, the following information

   1) Nominal water capacity, in litre.
   2) Solvent to be used.
   3) Mass of solvent, in kilogram.
   4) Maximum acetylene content, in kilogram.
   5) Test pressure of the cylinder shell, in $kgf/cm^2$.

b) A description of the porous mass as it exists in the cylinder which gives sufficient information concerning raw materials, specifications and procedure for testing, production process, quality control, testing and inspection procedures.

c) A report on the porosity determinations carried out by, the manufacturer on test cylinder, according to the method given in Annex B and declaration of the maximum and minimum limits of porosity within which the porous mass will be manufactured.

**20.1.4** *Declaration of the Manufacturer*

The request for approval shall be accompanied by a declaration from the manufacturer stating that in the event of approval is granted, the production of the porous mass will be in accordance with the information given in the request for approval in **20.1.3**.

**20.2 Submission of Cylinders for Test**

**20.2.1** The manufacturer shall submit an adequate number of cylinders including spare cylinders to the inspection authority which shall with stand successfully the appropriate type tests **20.3** and **20.4** and **20.6** prior to approval being granted to the request made by the manufacturer.

**20.2.2** The cylinders shall be selected from the sizes specified in **20.1.2**. These cylinders shall be complete with all accessories including porous mass, solvent and saturation gas, unless otherwise specified by inspecting authority.

**20.2.3** The inspecting authority has the right to witness the filling of the porous mass and to select and the number of the cylinders which are to be tested.

**20.2.4** Cylinders of each size selected for test by the inspecting authority shall be tested as follows:

a) Two cylinders shall be subjected to the porosity test in accordance with Annex B.

b) Two cylinders shall be subjected to the crushing strength as per Annex C.

c) Three cylinders shall be subjected to the elevated temperature test in accordance with section **20.3**.

d) Four additional cylinders shall be subjected to the vibration test as specified in **20.4** out of which one shall be sectioned longitudinally for examination while the remaining three cylinders shall be further subjected to drop treatment followed by back fire test specified as in **20.5**.

e) If the cylinder shell has joggle welds, three cylinders of the largest and three cylinders of the smallest water capacity shall be subjected to the test of the integrity of the porous material in the area of joggle welds in accordance with Annex E.

f) For cylinders equipped with fusible plugs, three cylinders shall be subjected the bone fire test as specified in **20.6**.

**20.3 Elevated Temperature Test**

**20.3.1** This test shall be carried out on cylinders which have been filled with solvent and charged with acetylene confirming to IS 308 to the maximum content as prescribed by the manufacturer plus an overcharge of 5 percent acetylene.

**20.3.2** Each cylinder shall be placed in a water bath the mean temperature of which is maintained at 65 ± 2°C, until the pressure in the cylinder constant or the

pressure curve shows that hydraulic pressure has developed.

**20.3.3** If during this test, the pressure curve indicates that hydraulic pressure has developed in the cylinder, or if the maximum pressure in the cylinder exceeds the cylinder test pressure the cylinder has failed.

**20.3.4** All cylinders selected are required to pass the elevated temperature test.

### 20.4 Vibration Test

**20.4.1** Cylinders with saturation gas shall be subjected to vibration test.

**20.4.2** The purpose of the test is to examine the behavior of the porous substance in the cylinder under those conditions such as occurring during transportations. The test shall be carried out as detailed in **20.4.3**.

**20.4.3** The cylinders will saturation gas shall be placed in a vertical position on a apparatus so arranged as to subject the cylinder to successive drops from a height of not less than 100 mm, so as to strike the end of the cylinder on a steel or cast iron surface solid supported by a concrete foundation or equivalent. Cylinders shall be subjected to this drop 5 000 times consecutively.

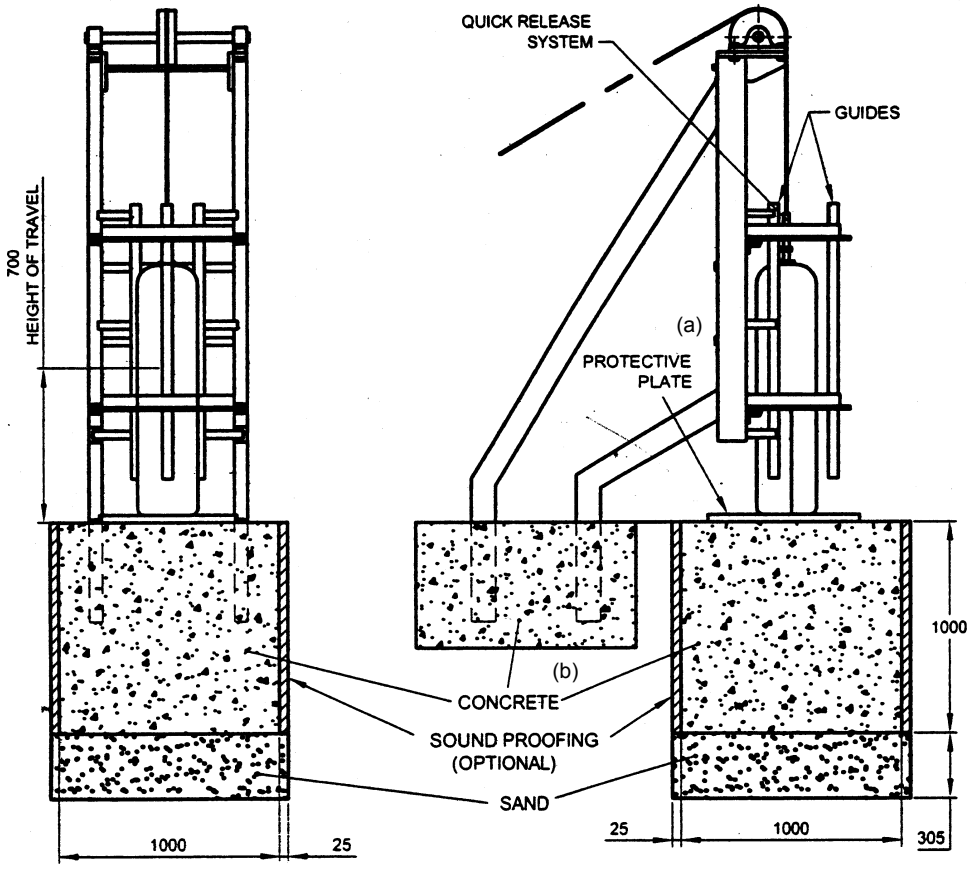
**20.4.4** The cylinders will then be sectioned longitudinally and the filling mass carefully examined. To meet the requirements of this test no appreciable setting or breaking up of the filling mass shall be noted after this treatment nor shall there be any voids in the filing material. The two halves so cut shall be photographed in full size.

### 20.5 Backfire Test

The back fire test comprises two steps, drop treatment **20.5.1** followed by the back fire procedure **20.5.2**.

**20.5.1** *Drop Treatment*

**20.5.1.1** Each cylinder shall be filled with the mass of solvent as specified by the manufacturer and saturated with acetylene conforming, to IS 308 at atmospheric pressure. It shall be dropped 10 times with negligible friction between the cylinder and the guides from a height of 0.70 m on to a concrete block covered with a protective plate similar to that as shown in Fig. 3.




a) The protective plate shall consist of 25 mm thick plate.
b) Recommended concrete grade for foundation below the plate is required. The concrete shall be cast in one piece. It is important that the surface on which the protective plate is placed be smooth and horizontal.

All dimension in millimetres.

FIG. 3 TYPICAL APPARATUS FOR THE DROP PROCEDURE

**20.5.1.2** Each cylinder shall be fitted with a device (valve and safety plugs) that will prevent loss of cylinder contents during the drop treatment.

**20.5.1.3** Any subsidence or other defect of the porous mass which has taken place during the drop treatment shall not be corrected before submitting the cylinders to the backfire procedure.

**20.5.2** *Backfire Procedure*

**20.5.2.1** *Explosion tube*

For the purpose of this procedure the cylinder, after having undergone the drop treatment in **20.5.1**, shall be fitted with an explosion tube directly connected to the cylinder similar to that as shown in Fig. 4. The capacity of the explosion tube shall be 75 ml with an internal diameter of 30 mm terminating in a passage 4mm in diameter with a length of 70 mm, connecting directly into the cylinder. The explosion tube shall be provided with the means of ignition consisting of a suitable wire, such as tungsten, 0.2 mm in diameter and 15 mm in length.

**20.5.2.2** *Acetylene charging*

The cylinders fitted with the appropriate equipment shall be charged with acetylene, conforming to IS 308, to the maximum acetylene content proposed by the manufacturer plus an overcharge of 5 percent, taking all necessary steps to purge the cylinder of non-soluble gases as far as is practicable.

**20.5.2.3** *Test sequence*

After filling, each cylinder shall be subjected to the following procedure:

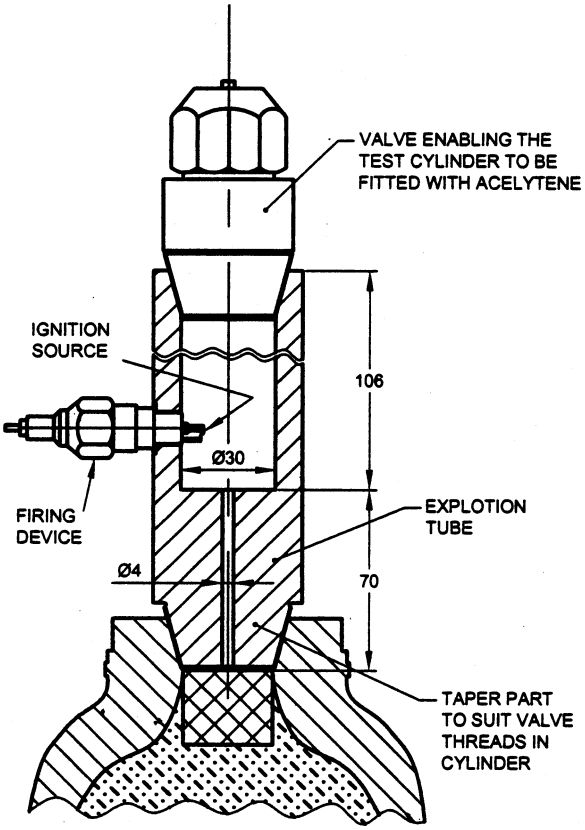
a) Stored horizontally for at least three days at a temperature of 15°C (+ 5°C/–0°C).

b) Placed vertically in water bath, maintained at a temperature of 35°C with a maximum variation of +1°C for three hours except for cylinders below 10 litre water capacity in which case the heating time shall be one-and-a-half hours. The maximum pressure shall also be recorded.

c) Placed vertically in the firing test position and fired when the pressure inside the cylinder has fallen to a value 3 to 4 percent below the maximum pressure attained in the cylinder during its heating as described in (b) above. Adequate precautions against the possibility of a cylinder bursting shall be taken in carrying out this procedure.

d) There shall be an adequate means of verifying that the required energy has been provided to initiate the acetylene decomposition in the explosion tube (e.g. by inspection of the wire after firing to ensure that it has fused).

e) If there is evidence of a fault in the equipment or in the procedure, the test shall be repeated.




All dimension in millimetres.

FIG. 4 TYPICAL EXPLOSION TUBE FOR BACKFIRE PROCEDURE

**20.5.2.4** *Failure criteria*

A cylinder has failed the test if it bursts, or if there is any release of gas from safety devices within 24 h of the backfire test.

**20.5.2.5** All cylinders selected are required to pass the backfire test. The cylinders passing the type test shall be destroyed.

### 20.6 Bonfire Test

Bonfire test shall be conducted on cylinders having safety devices according to **10.2**. The fully charged cylinder, connected to a remotely located recording or continuously observed pressure gauge which can be observed during the course of the test, shall be placed horizontally on a rack. While on the rack the cylinder shall be subjected to the fire resulting from the combustion of the following pieces of dry, yellow pine, or similar timber:

a) 80 pieces of 25 × 25 × 300 mm

b) 40 pieces of 25 × 50 × 750 mm

c) 40 pieces of 25 × 50 ×1 000 mm

The pieces of timber shall be arranged around the cylinder and two litres of kerosene shall then be poured over the timber, in such a manner that it is mainly

absorbed by the timber. Paper may be used to assist in the firing of the timber.

The test shall be considered satisfactory when there is at least a 170 kPa (1.734 kgf/cm$^2$) increase in the cylinder pressure, prior to release of a fusible plug and when the fusible plug releases within 10 min from the time the fire was started.

The cylinder shall be considered satisfactory when there is no appreciable bulging of the shell, no extensive penetration of the filler by decomposition, and no break up of the filling material.

### 20.7 Failure of Type Tests

If a cylinder fails in any of the type tests given in **20.3**, **20.4**, **20.5** or **20.6**, all the type tests shall be repeated for type approval.

## 21 MARKING

### 21.1 General Instructions

a) Each cylinder shall be clearly and permanently marked in accordance with the following conditions by stamping or similar processes on such a part which is inseparately bound with the cylinders which is not or only negligibly affected by stresses due to the gas pressure within it.

b) The name plate shall not be affixed to the cylinders shoulder if there is a risk of corrosion or embrittlement.

c) In conjunction with the original markings, space shall be provided for stamping the date of the test.

d) Marking shall be legible and their size shall be 6 mm minimum.

e) The stamps used for marking shall have small radii at changes of section to avoid formation of sharp edges in the stamped marking.

### 21.2 Permanent Marking

Each cylinder shall be permanently marked on the shoulder or on a reinforced part of the cylinder or on the collar or neck ring, provided it can be demonstrated in the bursting test that fracture does not initiate in these markings, with the following permanent marking:

a) The number of this standard;

b) Gas identification 'ACETYLENE' and the chemical symbol $C_2H_2$;

c) Identification of the manufacturer and owner together with the serial number of the completed cylinder;

d) Identification of the porous mass;

e) Tare weight in kg;

f) Maximum mass of the acetylene to be charged into the cylinder not inclusive of the saturation mass of acetylene, in kg;

g) Identification of the solvent when not acetone;

h) Working pressure at 15°C, in MPa (*see* **3.13**);

j) Water capacity, in litres;

k) Test pressure, in MPa;

m) Date of filling of porous mass;

n) A symbol to indicate the nature of heat treatment;

p) Inspector's official mark;

q) Inspecting authority licence No.;

r) Weight of solvent, in kg; and

s) Inlet thread (neck thread).

### 21.3 BIS Certification Marking

**21.3.1** Each cyliner may also be marked with the Standard Mark.

**21.3.2** The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Acts,* 2016 and the Rules and Regulation made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

### 21.4 Colour Identification

Each cylinder shall be given zinc or aluminum metal coating over which it shall be painted in accordance with IS 4379 for the identification of the contents.

## 22 RECORDS

A record shall be kept of all tests made at the cylinder manufacturers works and copies shall be made available to the inspecting authority and purchaser of the cylinder (if desired). A Test certificate duly approved and signed by the inspecting authority shall be forwarded to the statutory authority and the purchaser.

a) Certificate of analysis covering the material of the sheet of which the particular cylinder was made;

b) Result of the tensile test;

c) Result of the hydrostatic stretch test indicating compliance only;

d) Result of leakage test indicating compliance only;

e) Water capacity in kg;

f) Weight of each cylinder when empty and dry plus those of fusible plugs, valve pad and footring, if any, and any part permanently attached to the cylinder, but not including valve or cap;

g) Weight of complete cylinder, that is, weight

of item (f) plus weight of porous filling, but not including valve or cap;

h) Weight of cylinder in item (g) plus weight of saturation gas, solvent at atmospheric pressure and valve, but not including valve cover, if any; and

j) Type of porous filling and percentage porosity of the filling material.

## ANNEX A

(*Clause* 2)

### LIST OF REFFERED INDIAN STANDARDS

| *IS No.* | *Title* |
|---|---|
| 170 : 2004 | Acetone — Specification (*fourth revision*) |
| 308 : 1988 | Dissolved acetylene (gas) (*third revision*) |
| 817 : 1966 | Code of practice for training and testing of metal are Welders |
| 1079 : 2017 | Hot rolled carbon steel sheet plate and strip — Specification (*seventh revision*) |
| 1182 : 1983 | Recommended practice for radiographic examination of fusion welded but joints in steel plates (*second revision*) |
| 1875 : 1992 | Carbon steel billets, blooms, slabs and bars for forgings (*fourth revision*) |
| 2062 : 2011 | Hot rolled medium and high tensile structural steel (*seventh revision*) |
| 2825 : 1992 | Code for unfired pressure vessels. |
| 3196 (Part 3) : 2012 | Welded low carbon steel cylinders exceeding 5 litre water capacity for low pressure liquelible gases : Part 3 Methods of test (*fifth revision*) |
| 3224 : 2002 | Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders (*third revision*) |
| 3657 : 1978 | Radiographic image quality indicators (*first revision*) |
| 4379 : 1981 | Identification of content of industrial gas cylinders (*first revision*) |
| 6240 : 2008 | Hot rolled steel plate (up to 6 mm) sheet and strip for the manufacturer of low pressure Liquefiable gas cylinder (*fourth revision*) |
| 7241 : 1981 | Glossary of terms used in gas cylinder technology (*first revision*) |
| 7283 : 1992 | Hot-rolled bars for production of bright bars |
| 7285 | Refillable seamless steel gas cylinders — Specifications : |
| (Part 1) : 2018 | Normalised (*fourth revision*) |
| (Part 2) : 2017 | Quench and tempered (*fourth revision*) |
| 9550 : 2001 | Bright steel bars — Specification (*first revision*) |
| 9639 : 2017 | Visual inspection of low pressure welded steel gas cylinder during manufacture — Code of practice (*first revision*) |
| 13497 : 1992 | Fusible plugs for dissolved acetylene gas cylinders — Specification |

NOTE — The standards referred above should be read with latest revisions and amendments irrespective to their original dates mentioned above at the time of references.

# ANNEX B

[*Clauses* 19.2.4, 20.1.3 c) *and* 20.2.4 a)]

## DETERMINATION OF POROSITY OF THE POROUS MASS

**B-1** A cylinder filled with the porous mass shall be fitted with a valve and weighted. It shall be subjected to the action of vacuum so that, after standing for 12 h with the valve closed, the pressure does not exceed 2.666 kN/m$^2$ (0.027 2 kgf/cm$^2$). It shall be then filled with acetone under pressure not exceeding 1569 kN/m$^2$ (16 kgf/cm$^2$). when the acetone no longer penetrates, the valve shall be closed and the cylinder weighed.

**B-2** The cylinder shall be again subjected to the action of vacuum for 15 min and further acetone admitted. The cycle of operations shall be repeated until all air is expelled from the cylinder and constant weight obtained.

**B-3** The cylinder shall be then placed in a room where the temperature is constant, leaving the valve open and connected to a vessel containing acetone, for a period of 24 h.

**B-4** The valve shall be then closed, the acetone container disconnected and the cylinder weighed.

**B-5** The difference between the final weight and that of the cylinder before the introduction of the acetone represents the weight of acetone introduced.

**B-6** The porosity is given by the following formula:

$$P = 100 \times \frac{w}{v \times d}$$

where,

$P$ = porosity in percentage,

$w$ = weight of acetone introduced, in kg.

$v$ = the water capacity of the cylinder in litres without porous mass, and

$d$ = density of acetone at the temperature at which the cylinder is finally weighed, in kilogram per litre.

# ANNEX C

[*Clauses* 19.2.5 *and* 20.2.4 b)]

## DETERMINATION OF CRUSHING STRENGTH OF THE POROUS MASS

### C-1 PRINCIPLE

At ambient temperature a test piece of specified dimensions is subjected to an increasing load until either the test piece collapses or its height is reduced to 90 percent of its original value. The crushing strength is calculated from the maximum force and the dimensions of the test piece.

### C-2 APPARATUS

**C-2.1** Mechanical or hydraulic crushing strength machine that will enable the load to be increased progressively and smoothly, and with a system of measurement that will enable the force exerted on the test piece to be known within ± 2 percent shall be used. One of the platens of the machine shall be mounted on a spherical seating that will compensate for any small error of parallelism between the face of the test piece and the platen. The platens of the machine shall be ground and the lower one shall be marked so as to facilitate placing the test piece at its centre.

**C-2.2** Micrometer, or other suitable instrument shall be used to measure the deformation of the test piece.

**C-2.3** Equipment to measure the size of each test piece and to verify its geometrical form.

**C-2.4** Drying oven, capable of being controlled a 110 ± 5°C.

**C-2.5** Desiccator for cooling the specimen.

### C-3 TEST PIECES

**C-3.1** Section the cylinder tested for porosity according to **19.3.1** into two pieces and recover the porous mass from each half. Discard 50 mm from the top and bottom of the porous mass. From the balance porous mass make one cube each from top, middle and bottom one-third of the mass. Inspect the cubes for voids, cracks, water marks, etc. The cubes shall not have the above said defects.

**C-3.2** The sides of test cube shall be of 45 ± 1 mm size.

**C-3.3** The load bearing faces of each test pieces shall be parallel within a tolerance of 1 mm. This condition shall be checked by making four measurements of the height of the test piece, one at the centre of each of its four sides; the measurement shall not differ among themselves by more than 1 mm.

**C-3.4** The axis of each test piece shall be perpendicular to its base within a tolerance of 1 mm. This condition shall be checked by placing the test piece on a surface table or surface plate and presenting a set square to the centre of each of its four sides: any gap between the set square and the side of the test piece shall not exceed 1 mm.

### C-4 PROCEDURE

**C-4.1** Measure the sides of each load-bearing face of the test piece to the nearest 0.5 mm

**C-4.2** Dry the test piece to constant mass in the oven, controlled at 110 ± 5°C for a maximum period of 8 h and cool it to room temperature in a desiccator.

**C-4.3** Place the test piece on one of its faces in the centre of the lower pattern of the testing machine.

**C-4.4** Gradually and continuously increase the load.

**C-4.5** Continue increasing the load until the test piece collapses (fails to support the load). Record the maximum load indicated during the test.

### C-5 EXPRESSION OF RESULT

**C-5.1** The crushing strength is given, in newtons per square millimeter, by the formula

$$C = \frac{F_{max}}{A^2}$$

where,

$C$ = crushing strength of the porous mass;

$F_{max}$ = maximum load, in newtons indicated during the test; and

$A$ = mean of the four measurement of the each side of the top face, in millimetres.

**C-5.2** The crushing strength shall be expressed in newtons per square millimeter, to the nearest 0.1 N/mm$^2$.

NOTE — The SI unit for crushing strength is the Newton per square meter, but the Newton per square millimetre has been chosen for practical reason.

## ANNEX D

(*Clauses* 3.13 *and* 19.1.2)

### CALCULATION OF THE WORKING PRESSURE

**D-1** The working pressure at a uniform reference temperature of 15°C in a cylinder containing the maximum acetylene content and the specified solvent content shall be calculated by the following equation (rounded up to the next integer).

$$P_w = a_1 \times \frac{\frac{m_A}{m_s} + a_2}{\frac{m_A}{m_s} + a_3} + 1.7$$

where

$P_w$ = working pressure, in bar;

$m_A$ = maximum acetylene content, in kg;

$m_S$ = specified solvent content, in kg; and

$a_1$, $a_2$, $a_3$ = constants with value as given in table below:

| *Constant* | *Solvent* | |
|---|---|---|
| | Acetone | DMF |
| $a_1$ | 59.853 | –50.671 |
| $a_2$ | –0.0 202 | 0.0 958 |
| $a_3$ | 1.5 247 | –2.5 253 |

The constants are taken from MILLER

# ANNEX E

(*Clauses* 7.6, 19.2.8 *and* 20.2.4)

## TESTING OF THE INTEGRITY OF THE POROUS MASS IN THE AREA OF JOGGLE WELDS

### E-1 PROCEDURE

This test may be carried out by or on behalf of the manufacturer of the porous mass (material).

This test shall be carried out using cylinders that have not previously been filled with solvent or acetylene.

Two cylinders of the largest and two cylinders of the smallest water capacity shall be subjected to the drop treatment as specified in **20.5.1**. They shall be sectioned longitudinally and inspected for voids and damage to the porous mass (for example excessive clearance, cracks, disintegration) in the area of the cylinder welds. The porous mass (material) shall not show excessive voids or damage.

### E-2 CRITERIA

For passing the type test, the porous mass (material) shall not show excessive voids or damage and shall not be loose in the area of the joggle welds in any of the cylinders. In general, the test should be considered to have passed if the largest diameter of the voids between the porous mass (material) and the area of the joggle welds of the cylinder are smaller than 3 mm or the maximum allowed top clearance ( whichever is the smaller) and if no cracking has been caused that would loosen the porous mass (material).

# ANNEX F

(*Foreword*)

## COMMITTEE COMPOSITION

Gas Cylinders Sectional Committee, MED 16

| *Organization* | *Representative*(*s*) |
|---|---|
| Petroleum and Explosive Safety Organization, Nagpur | Shri T. R. Thomas (***Chairman***)<br>Shri Ashendra Singh (*Alternate*) |
| All India Industrial Gases Manufacturers Association, New Delhi | Shri Saket Tiku<br>Shrimati Veena Peter (*Alternate*) |
| Ashok Leyland Limited, Chennai | Shri M. Ravi<br>Shri S. Arun (*Alternate*) |
| Bharat Petroleum Corporation Ltd, Mumbai | Shri Vishnu D. Sonawane<br>Shri A. Prabhakar (*Alternate*) |
| Bharat Pumps and Compressors Ltd, Allahabad | Shri Mohan Kumar<br>Shri P. G. Choudhury (*Alternate*) |
| BOC India Ltd, Kolkata | Shri Ramana Vutukuru<br>Shri Pradeep (*Alternate*) |
| Everest Kanto Cylinder Ltd, Mumbai | Shri P. M. Samvatsar<br>Shri A. K. Khamkar (*Alternate* I)<br>Shri H. D. Khatri (*Alternate* II) |
| GSPC Gas Co Ltd | Shri K. S. R. Prasad |
| Hindustan Petroleum Corporation Ltd, Mumbai | Shri S. Nandi<br>Shri P. N. Kanth (*Alternate*) |
| Indian Oil Corporation Ltd, Mumbai | Shri S. M. Rambhal |
| Indraprastha Gas Limited, Delhi | Shri Praveen K. Pandey<br>Shri Alok Sharma (*Alternate*) |
| International Industrial Gases Ltd, Kolkata | Shri Devendra K. Garg<br>Shri Nikhilesh K. Garg (*Alternate*) |
| Kabsons Gas Equipments Ltd, Hyderabad | Shri Satish Kabra<br>Shri Kunal Kabra (*Alternate*) |
| Kosan Industries Ltd, Mumbai/Surat | Shri S. K. Dey<br>Shri S. B. Bomal (*Alternate*) |
| LPG Equipment Research Centre, Bangalore | Shri P. Krishnan Kutty<br>Dr A. Krishna (*Alternate*) |
| Mahanagar Gas Limited, Mumbai | Shri S. Murali<br>Shri Arun Nayak (*Alternate*) |
| Maruti Koatsu Cylinders Ltd, Mumbai | Shri Nitin J. Thakkar<br>Shri A. S. Saran (*Alternate*) |
| Ministry of Defence (DGQA), Pune | Shri J. P. Tiwari, Jasg<br>Shri K. Sudhakaran (*Alternate*) |
| Praxair India Ltd, Bangalore | Shri Milan Sarkar<br>Shri Arindam Das (*Alternate*) |
| Research & Development Estt (Engineers), Pune | Shri P. K. Chattopadhyay<br>Shri A. Basu (*Alternate*) |
| Sakha Engineers Pvt Ltd, New Delhi | Shri Amarjit S. Kohli |
| SICGIL India Ltd, Chennai | Shri Farooque Dadabhoy<br>Shri R. Padmanaban (*Alternate*) |
| Society of Indian Automobile Manufacturers (SIAM), New Delhi | Shri K. K. Gandhi<br>Shri Amit Kumar (*Alternate*) |
| Steel Authority of India Ltd, Salem | Shri M. Prabakaran<br>Shri N. K. Vijayavargia (*Alternate*) |
| Steel Authority of India Ltd, Ranchi | Shri Debashis Karmakar<br>Dr B. K. Jha (*Alternate*) |

| *Organization* | *Representative*(*s*) |
|---|---|
| Supreme Cylinders Ltd, Delhi | Shri M. L. Fathepuria |
| Tata Motors Ltd, Pune | Shri P. K. Banerjee<br>Shri Amul Verma (*Alternate*) |
| Tekno Valves, Kolkata | Shri Y. K. Behani<br>Shri R. Behani (*Alternate*) |
| The Automotive Research Association of India, Pune | Dr S. S. Thipse<br>Shri S. D. Rairikar (*Alternate*) |
| Trans Valves (India) Pvt Ltd, Hyderabad | Shri A. K. Jain<br>Shri P. K. Mathor (*Alternate*) |
| Vanaz Engineers Ltd, Pune | Shri K. P. Velayudhan<br>Shri S. J. Vispute (*Alternate*) |
| In personal capacity (*Menon & Patel, 14/1, Mile, Mathura Road, Faridabad*) | Shri Ebrahim M. Patel |
| In personal capacity (*303, Shantikunj, Pandav Bunglows Lane Athwalines, Surat*) | Shri L. D. Thakkar |
| BIS Directorate General | Shri T. V. Singh, Scientist 'F' and Head (MED)<br>[Representing Director General (*Ex-officio*)] |

*Member Secretary*
Shri Vishal Tomer
Scientist 'C' (MED), BIS

## Dissolved Acetylene Cylinders, Generators, Acetylene Pipe Lines and High Pressure Gas Cylinders Subcommittee, ME 16:3

| *Organization* | *Representative*(*s*) |
|---|---|
| BOC India Ltd, Kolkata | Shri Vutukuru Ramana (*Convener*) |
| Al-Can Exports Pvt Ltd, Distt Thane | Shri Vijay K. Parikh<br>Shri D. C. Dave (*Alternate*) |
| All India Indl Gases Manufacturers Association, New Delhi | Shri Saket Tiku<br>Smt Veen A. Peter (*Alternate*) |
| Bharat Pumps and Compressors Ltd, Allahabad | Shri Mohan Kumar<br>Shri P. G. Choudhury (*Alternate*) |
| Everest Kanto Cylinder Ltd, Mumbai | Shri P. M. Samvatsar<br>Shri A. K. Khamkar (*Alternate* I)<br>Shri H. D. Khatri (*Alternate* II) |
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This Indian Standard has been developed from Doc No.: MED 16 (1205).

**Amendments Issued Since Publication**

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Published by BIS, New Delhi